



Reassessment of Oil market volatility and Stock market volatility: Evidence from Selected SAARC countries

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ABSTRACT

Volatility spillover provides information about information transmission from one market to another market, and the world economy has recently experienced several fluctuations in energy prices and financial markets. This has motivated academics, investors, and policymakers to analyze the relationship between energy prices and stock markets. Empirical research in such a field is crucial since numerous studies argue that oil price is one of the major indicators for an economy, and hence changes in its volatility can have substantial impacts on the stock market. This paper examines whether the volatility of the global oil market spills over to the equity markets of selected SAARC countries. Monthly data from February 2013 to September 2019 is utilized in the study in order to obtain updated evidence about the transmission of the volatility of global oil prices to the equity markets of the SAARC member countries. The bivariate EGARCH model is used to test for volatility transmission from the oil market to the equity market. Findings suggest that shocks in oil prices have no significant impact on the volatility of the equity markets, except in Bangladesh. Policymakers can utilize these findings when making policy decisions.

1. Introduction

SAARC countries' stock markets have been growing rapidly over the last few decades. That has created many investment opportunities in those markets, leading to increased capital inflows from developed to emerging markets (Beckmann et al., 2015). Oil is the world's most widely used and traded product and remains the backbone of any economy. Because of recent significant oil price fluctuations, research on oil markets got a proven boost as it has a wide impact on the business cycle of any economy. South Asian market is considered one of the largest consumers of crude oil and petroleum-related products. For instance, India is the fourth-largest net importer of crude oil and petroleum products after the USA, China, and Japan (US Energy Information Administration, 2014). In addition, India is currently importing more than 70 percent of its crude requirements (Integrated Energy Policy (IEP) document published by the Planning Commission in India), and such dependence might go up to 90 percent due to limited supply and stagnation in domestic production (Ghosh and Kanjilal, 2016). Likewise, Pakistan and Sri Lanka also import huge amounts of crude oil and related products. In Pakistan, the oil import expenditures account for one-third of its total import bill as well. Oil is an important commodity in the South Asian region since all these countries mainly produce agricultural products, and different sectors, such as industry, transport, and agriculture, are highly dependent on crude oil. Thus, oil price shocks seem to have significant influences on the economies considered. Also, stock markets represent the economic condition of any country (Hamilton & Herrera, 2004; Kilian, 2008; Korhonen & Ledyeva, 2010). Therefore, it is important to study the dynamic link between global oil prices and the stock returns of the selected emerging markets (Filis et al., 2011; Wen et al., 2012; Awartani & Maghyereh, 2013; Ewing & Malik, 2016; Maghyereh et al., 2017; Kang et al., 2017). Even though research on oil prices and stock market returns is not scant, many studies have found that the relationship between the stock market's returns and oil prices is still inconclusive (Alamgir, 2021; He, 2022).

Many studies have been focused on analyzing the correlation between stock and commodity prices because of their diversification advantage in the economy (Creti, 2013; Brooks, 2013). Tiwari and Sahaduddeen (2015) conducted one study where they used oil and gold as the most highly liquid commodities and found that there is movement in stock market returns as oil and gold are included in the portfolio. Investors are motivated to add commodities like gold and oil into their portfolios. Economic downturns have a negative impact on investors' returns, e.g., the economic crisis of 1970, the Russian Crisis-1997, the Asian financial crisis-1998, and the global financial crisis-2007-2009. In such downturns, investors are encouraged to look for alternative investments for their asset diversifications to avoid return losses. To hedge the risk, a portfolio construction strategy remains the focus for all of the individual investors suggested by researchers and investment managers that will bring back investors' confidence in financial markets and helps the investors to prevent sudden losses because of market turmoil. A few research papers have been analyzing the oil prices index as an asset in portfolio optimization in connection to stock returns, and researchers have found that there is a significant association between this asset class in portfolio optimization (Hammoudeh & Li, 2004; Park & Ratti, 2008; Imarhiagbe, 2010; Falzon & Castillo, 2013; Degiannakis et al., 2014; Lin & Appiah, 2014; Khalfaoui et al., 2015; Wang & Liu, 2016).

According to a report generated by Jadwa Investment (2015), Investor sentiments are affected by oil price fluctuations in the international market because individual investors generate 90% of trading volumes, and these sentiments drive the investors to make investment decisions. According to Alturki and Khan (2015), Saudi Arabia is a major oil exporting country globally, and 86% of the Saudi government's revenue comes from oil and related products. Oil price fluctuations in the international market affect the Saudi government's expenditures and stock market returns. In addition to that, Raza. N et al. (2016) explained that all emerging markets are less impacted by oil price changes. Global oil prices show a rapid decline from the starting month of 2013 to mid of 2015 and then increase steadily. In this regard, Noor and Dutta (2017) found the negative volatility spillover of oil prices on the volatility of the equity markets of specific SAARC member countries, including Sri Lanka, India, and Pakistan. However, Chittedi (2012) found no volatility transmission from oil prices to Indian equity markets. The mixed results from the above studies for volatility spillover of oil prices on the volatility of the equity market could be dedicated to using different data frequencies, different econometric models, and different measurements of variables. Regarding the mixed results and changing patterns of global oil prices, this current study aims to provide updated evidence of volatility spillover from global oil prices to the stock markets of the SAARC member countries.

The present study contributes to the literature in multiple ways. First, the study investigates the volatility spillover of Global oil prices on stock returns in selected SAARC countries that is more effective than just cause and effect relationship between the monetary values of variables. Second, the study uses prices of two different oil standards, including Brent oil and WTI, that ensure the consistency and reliability of results. Third, the study employed the EGARCH model, which allows for the leverage effect and is more efficient than the simple GARCH model and other linear regression models. Also, the EGARCH model can capture the different patterns of stock returns with fluctuations in oil prices. Fourth, oil and stock prices are time-varying variables, so continuous screening and investigation are needed. Therefore, the current study provides updated evidence about the relationship between oil prices and stock returns.

The remaining paper is distributed as follows: the second part provides a literature review, the third part provides a detailed research design; the fourth part comprises the results and discussion; the fifth part provides the study's conclusion.

2. Theoretical Background and Hypotheses Development

Oil price fluctuations affect international markets (Mohaddes, 2017; Kilian, 2014). In recent years, world economies have experienced downturns in their growth because of Covid 19, which changed energy and non-energy prices and motivated academics and policymakers to understand the relationship between energy and non-energy commodity prices (Khalfaoui, 2021). In this regard, a few studies have discussed that Oil price fluctuations contribute to the global recession (Hamilton, 1983; Mork, 1989). However, Kilian (2009) found a negative correlation with GDP, which suggested that oil price fluctuations are not affecting the economies at a larger scale. In addition, Jones and Kaul (1996) also found that oil price fluctuations negatively impact the stock market returns of four developed countries, including the United States, Japan, Canada, and the United Kingdom.

In contrast, Sadorsky (2001) found that oil prices and stock market returns are positively correlated in the Canadian market. The stock markets' key factors are interest rate, risk premium, and exchange rate. Fayyad and Daly (2010) also found a positive association between oil prices and equity returns in the Gulf Cooperation Council (GCC) counties, including UAE, UK, USA, Oman, Kuwait, Bahrain, and Qatar. Yurtsever and Zahor (2007) and Gogineni (2008) also found that oil prices and stock market returns are positively correlated in Netherlands and United States markets. A few studies have also found that there isn't any relationship between oil prices and equity returns (Wei, 2003).

Further, Arouri and Nguyen (2010) studied that macroeconomic variables are affected by oil price fluctuations, including inflation, income level, interest rate, the confidence of investors, and production cost. US and European stock markets data were used by Arouri et al. (2011) to inquire about the relationship between the oil price and stock market returns spillover by using the VAR-GARCH model to study whether oil as assets play any role in hedging the portfolio risk and found that in hedging portfolio risk and for portfolio optimization oil plays a critical role as an asset. Using asymmetric effects, Raza et al. (2016) also studied the developed markets and found a significant negative relationship between oil prices and stock market returns.

Emerging economies are also affected negatively by oil price volatilities. Chittedi (2012) examined Pakistani stock market returns and oil prices in this regard. Empirical results showed that increasing oil prices lead to increased inflation. To cater to inflation, the State bank of Pakistan uses interest rates as a policy tool. When the interest rate goes up, investors move to the government bond market and increase that market's volume and decrease the stock market's volume, which ultimately lowers the stock market returns. In addition, Sarwar et al. (2020) examined the volatility spillover between oil and stock market returns of the Karachi stock exchange, Shanghai stock exchange, and Bombay Stock Exchange by using a bivariate BEKK-GARCH model covering the data from 1997 to 2004. Empirical results explained that volatility spillover between oil and the stock market in the Karachi stock exchange is bidirectional, unidirectional in the Shanghai stock exchange, and mixed with the Bombay stock exchange. However, Sarwar et al. (2010) also examined the volatility

spillover between oil assets and 107 Pakistani listed firms' stocks using the BEKK-GARCH model. They found that there is also an association between firms' stock to oil and from oil to stocks. Bouri et al. (2017) studied the Indian stock market returns with commodities markets (oil and gold). They found a positive relationship between the volatility spillover of Indian stock market returns and crude oils.

Bilgin et al. (2015) also studied the randomly selected ten Asian countries using the RV and GARCH model. They found that energy prices negatively affect Asian economies, specifically India, China, and Turkey. Thuraismy (2013) also examined the 14 Asian countries, mainly India, Pakistan, Bangladesh, and Sri Lanka, and found that volatility spillover shocks from developed markets tend to have spillover effects from crude oil future markets in these countries. However, Boubaker (2017) investigated the spillover effects of volatility between BRICS countries' equity market returns and oil prices using the ARMA-GRACH model and wavelet multiresolution analysis. Empirical results explained the time-varying volatility in all BRICS markets. Lin and Appiah (2014) studied the relationship between oil prices and stock market returns of Ghanaian and Nigeria in light of the volatility spillover. They found that when hedging the stock market risk, oil is the better alternative asset for investment. In addition, the Nigerian stock market was affected by oil price fluctuations, and volatility spillover was higher in that market. However, the Ghanaian stock market was more affected when hedging the portfolio risk. Further, Maghyereh et al. (2016) used data from eleven major stock exchanges from 2008 to 2015. They found that both oil prices and returns of stock markets are affected by news spillovers, creating an ambiguous economic environment.

Volatility spillover in oil export and oil import countries recently got the attention of energy economics experts because of the growing energy sector. In this regard, Guesmi (2014) studied the impact of oil prices fluctuations on stock markets considering volatility spillover in oil exports countries (Venezuela, Kingdom of Saudi Arabia, Kuwait, UAE) and oil imports countries (Venezuela, Kingdom of Saudi Arabia, Kuwait, UAE) by using a multivariate GJRDCG-GARCH model. They found that oil prices have significantly impacted the stock market returns of export and import-oriented countries in periods of global turmoil. Bouri (2015) studied the global financial crisis's-2008 effects on the countries, including Jordan and Lebanon, by focusing on volatility spillover. They found that oil prices and equity returns were significantly affected by economic crisis shocks considering volatility spillover in Jordan compared to Lebanon's oil-stock market. Gbatu et al. (2017) also inquired about the impact of oil price fluctuations on Lebanon's economy by using the ADL bounds test approach of Pesaran et al. (2001) and found that oil prices have a significant impact in the short run and Real GDP has a nexus with oil price fluctuations. Trabelsi (2017) also examined three major economies, including UAE, KSA, and Russia, using DCC-GARCH and Co Var measures and found that stock market indices and oil prices have a negative relationship. Bouri et al. (2018) used quantile response methods and multivariate regression quantile technique to see the relationship between countries that exports oil (Brazil and Russia) and that import oil (India and China) by applying a shock transmission mechanism. The empirical results revealed asymmetric effects on equities return, like adverse shocks in oil volatility, impact more on oil-importing economies, whereas positive shocks in oil volatility impact oil-exporting economies. Ping et al. (2018) examined the energy stock market in connection with fuel oil spots and fuel oil future markets volatility spillover by implementing DCC-GARCH and VAR-BEKK-GARCH frameworks and found that these markets have bidirectional effects in connection with volatility spillovers.

3. Research Methodology

3.1 Date and Variables

The study uses monthly time series data for the period February 2013 to September 2019 to investigate the volatility spillover between stock market returns and oil prices. For fair examination, the study uses the two most traded and popular benchmarks of oil commodities: West Texas Intermediate (WTI) and Brent North Sea Crude (Brent). The data of both benchmarks are obtained from Investing.com. The target sample of the study is SAARC member countries. However, the four major countries are included in the sample: Pakistan, Sri Lanka, India, and Bangladesh. These countries account for more than 90% market capitalization of the SAARC region. The market data of the countries are mined from a global market data forum, "Investing.com."

The prices are used at the percentage difference level calculated by using the following equations:

$$Ret_{(equity,WTI,Brent)} = \left[\frac{Price_t - Price_{t-1}}{Price_{t-1}} \right] \times 100 \quad (3.1)$$

Where $R_{(equity,WTI,Brent)}$ shows the returns/percentage change in oil prices and equity prices.

$Price_t$ shows the prices of the current month, whereas $Price_{t-1}$ represents the prices of the previous month.

3.2 Unit Root Test

The stationarity in data influences the behavior of variables and should treat the stationary and non-stationary variables (Brooks, 2019) differently. Therefore, the stationarity level for each variable is important before selecting the econometric model. The study uses the Augmented Dickey-Fuller test (ADF) and Phillip Perron unit root test (PP) to test the variables' stationarity. Table 2 summarizes the results of AD and PP. Both the tests show that the variables are stationary at first difference.

3.3 Econometric Model

To examine the volatility spillover effect between stock market returns and oil prices, Generalized Autoregressive Conditional Heteroscedastic (GARCH) and Exponential Generalized Autoregressive Conditional Heteroscedastic (EGARCH) models are employed. EGARCH model is an extended version of the GARCH model to investigate the leverage effect.

The GARCH model is widely used to study volatility, which allows for predicting the conditional variance on its lag terms (Brooks, 2019). The general equations of the GARCH model are given below:

$$y_t = \mu + \alpha y_{t-1} + u_t, \quad \epsilon_t \sim N(0, \delta_t^2) \quad (3.2)$$

$$\delta_t^2 = \beta_0 + \beta_1 u_{t-1}^2 + \gamma \delta_{t-1}^2 \quad (3.3)$$

This is a univariate standard GARCH (1,1) model, where equation 3.2 shows the conditional mean and equation 3.3 represent the conditional variance. The model can convert to order (p,q) by extending previous lags of u_t to qth order and lag terms of δ_t^2 to pth order, as given below:

$$\delta_t^2 = \beta_0 + \sum_{i=1}^q \beta_i u_{t-i}^2 + \sum_{j=1}^p \gamma_j \delta_{t-j}^2 \quad (3.4)$$

Where it shows the conditional variance, β_0 , β_i , and γ_j are the model's coefficients; i is a set of previous lags of the error term and j is set lag terms of the variance. The study employed a bivariate GARCH (1,1) model to check the volatility persistence. The specification of the models is shown below:

$$\delta_{t(Ret)}^2 = \alpha_1 + \beta_1 u_{t-1}^2 + \gamma_1 \delta_{t-1(Ret)}^2 + \omega_1 WTI_{t-1} \quad (3.5)$$

$$\delta_{t(Ret)}^2 = \alpha_2 + \beta_2 u_{t-1}^2 + \gamma_2 \delta_{t-1(Ret)}^2 + \omega_2 Brent_{t-1} \quad (3.6)$$

where $\delta_{t(Ret)}^2$, $\delta_{t(WTI)}^2$, and $\delta_{t(Brent)}^2$ are the conditional variance of stock market returns, WTI, and Brent, respectively. α_1 - α_4 are intercepts of the models. β_1 - β_4 are the coefficients of moving average terms (MA) that show the impact of the error term on the conditional variance. Similarly, γ_1 - γ_4 measures the effect of own lags of the variance on the variance of the current month. ω_1 - ω_4 shows the impact of the lag term of the independent variable in the model on the conditional variance of the dependent variable.

To investigate the leverage effect, the EGARCH model is a better solution that does not necessitate positive variances (Brooks, 2019). The conditional variance of the EGARCH model is given below:

$$\ln(\delta_t^2) = \alpha_0 + \beta \ln(\delta_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\delta_{t-1}^2}} + \varphi \left[\frac{|u_{t-1}|}{\sqrt{\delta_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \quad (3.7)$$

In the equation, $\ln(\delta_t^2)$ shows the natural log of conditional variance; β measures the persistence of volatility; γ gives the existence of asymmetric or leverage effect in the model, and φ provide the symmetric effect.

The specific equations for the conditional mean and the bivariate EGARCH model's conditional variance are developed in Kanas (2000) and Jebran and Iqbal (2016) guidance.

3.4 Volatility Transmission from WTI Oil prices to Stock Market

The algebraic equations of the bivariate EGARCH model to examine the volatility spillover or volatility transmission from WTI crude oil market returns to stock market returns are given below:

$$Ret_t = \alpha_0 + \alpha_1 Ret_{t-1} + \alpha_2 WTI_{t-1} + u_t \quad (3.8)$$

$$\ln(\delta_{t(Ret)}^2) = \beta_0 + \beta_1 \ln(\delta_{t-1(Ret)}^2) + \beta_2 \frac{u_{t-1}}{\sqrt{\delta_{t-1}^2}} + \varphi \left[\frac{|u_{t-1}|}{\sqrt{\delta_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] + \rho V_{(WTI)} \quad (3.9)$$

Where Ret shows the stock market returns and V represents the volatility of WTI and provide the spillover effects.

3.5 Volatility Transmission from Brent Oil prices to Stock Market

The bivariate EGARCH (1,1) model is employed to check the volatility spillover from the Brent Oil market returns to Stock market returns. The conditional mean and variance of the model are:

$$Ret_t = \alpha_0 + \alpha_1 Ret_{t-1} + \alpha_2 Brent_{t-1} + u \quad (3.10)$$

$$\ln(\delta_{t(Ret)}^2) = \beta_0 + \beta_1 \ln(\delta_{t-1(Ret)}^2) + \beta_2 \frac{u_{t-1}}{\sqrt{\delta_{t-1}^2}} + \varphi \left[\frac{|u_{t-1}|}{\sqrt{\delta_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] + \rho V_{(Brent)} \quad (3.11)$$

The coefficients and symbols have the same interpretations as provided in the later section.

The models are used separately for each country to investigate the bidirectional volatility spillover or volatility transmission between Stock market return and WTI oil prices; stock market return and Brent oil prices.

4. Results and Discussion

Before doing empirical analysis, the behavior of oil prices and stock market returns is visualized through univariate analysis, including univariate graphs and descriptive statistics. The trend of oil price and stock market price is shown in figure 1. The oil prices of both benchmarks, including WTI and Europe Brent oil index, were at a peak in the year 2012-13, showing a downward trend in the beginning months of 2014 and reaching the lowest level in 2015-16. After mid of the year 2015, the oil prices show an upward trend with minor shocks till the last month of the sample. Similarly, figure 2 represents the trends of equity markets of all four countries, including the KSE-100 index (Pakistan), BSE SENSEX index (India), CSE all-share index (Sri Lanka), and DSEX index (Bangladesh).

The descriptive statistics are shown in table 1. The average value of WTI and Brent is negative that is dedicated to the average oil price decline over the sample period. The average value of WTI is -0.65, which fluctuated between 21.38 and -24.55 with a standard deviation of 8.58. Similarly, the maximum value of Brent oil prices is 19.59, the minimum value is -26.64, and the standard deviation is 8.82. The mean values of stock returns of all the countries are positive over the sample period. India (Bombay stock exchange) shows the highest average returns, whereas Sri Lanka (Colombo stock exchange) has the lowest average stock returns. However, the Colombo stock exchange is more stable as it has the lowest standard deviation.

In contrast, the equity market of Pakistan (KSE-100 index) is highly volatile compared to the other SAARC member countries. The stock returns data of all the countries are normally distributed at 5% significance as the p-value of Jarque-Bera statistics is greater than 0.05 in the case of all countries. The series of WTI is normally distributed, whereas the normality hypothesis of Brent is not supported at a 5% significance level.

The results of the EGARCH model, which investigate the volatility transmission from the oil market to the equity market, are shown in table 3. Panel A of the table summarizes the results for WTI oil prices, whereas Panel B provides the results for Brent prices. The results show that the value of ρ is insignificant at a 5% significance level for both panels (A and B) for all the countries except Bangladesh, which is significant for WTI. This finding indicates that the volatility of global oil prices does not affect the equity markets of SAARC member countries. Only the volatility of WTI oil prices positively influences Bangladesh stock market returns. In other words, the stock market returns of the SAARC member countries do not significantly react to the shocks in global oil prices.

The coefficient of ARCH and GARCH (β_1 and ϕ) are insignificant in all the countries except Pakistan. The results show that the conditional variance model's volatility persistence and shock dependency exist only in Pakistan, meaning the previous shocks influence the conditional volatility of the stock prices. The coefficient of leverage effect (β_2) is negative in most countries but not significant in any of the countries, meaning that adverse shocks have no significantly higher influence than positive shocks. Therefore, positive shocks and adverse shocks have the same effect on the volatility of the stock market returns.

The coefficient of the mean equation (α_1) is negative for both the benchmarks of crude oil markets in India and Pakistan, which means the previous month's stock prices negatively influence the average prices of the current month. In contrast, the coefficient is positive for Bangladesh in the models of both crude oil benchmarks. However, the relationships are not statistically significant. The coefficient (α_2) is positive in the case of Pakistan and India in the models of both WTI and Brent, whereas mixed signs for Bangladesh and Sri Lanka, but not significant at a 5% significance level. These findings mean that fluctuations in the previous month's equity and global crude oil markets cannot predict the average stock market returns of the SAARC member countries.

The same relationships were investigated by Noor and Dutta (2017) in three South Asian countries, i.e., Sri Lanka, India, and Pakistan, through the VAR-GARCH model, and found unidirectional volatility spillover from global oil prices to equity markets. They used data from January 2001 to December 2014. The current study provides an updated version of the volatility spillover and includes another major SAARC member Bangladesh. Our findings are in contrast to the literature (Sarwar et al., 2010; Sarwar et al., 2020; Bouri et al., 2017; Thuraissamy, 2013; Boubaker, 2017) and the possible reason could be government subsidies and internal energy sources that may help in dumping the effect of shock in the global oil prices. Further, it may be possible that the companies have some defensive plans to overcome the instability of their stock prices. The statistical technique also plays a key role in the mixed results of the literature. Some effects might have different methods and time-varying data, producing different results. The findings of Chittedi (2012) show that volatility spillover exists from oil price to stock market return in the Indian equity markets. They used oil prices relative to stock market indices and investigated the impacts through the ARDL model.

5. Discussion

The study examines the volatility spillover from global oil prices to returns of stock markets of the SAARC member countries, namely Pakistan, India, Sri Lanka, and Bangladesh. For empirical analysis, monthly data is used. As literature mainly focused on developed economies or investigated the simple cause-and-effect relationship between the monetary values of oil prices and stock prices by using correlation-based statistical techniques. Therefore, the current study makes worthy contributions by examining the volatility spillover of oil prices on stock returns in developing countries and using the EGARCH model that allows for asymmetric/leverage effects of positive and negative shocks. Two popular oil benchmarks (WTI and Brent) are considered to obtain more consistent results. The results of the EGARCH model show that volatility does not transmit from global oil prices to the equity markets of the selected SAARC countries. The above findings can guide investors in the future to look for such changes in the commodities markets when making portfolios.

6. Implications and Limitations

The findings are important for investors in making portfolio decisions. Investors must consider oil price shocks in their stock market returns and create a diversified portfolio. Although literature argues the significant impact of oil prices on stock returns, the current study argues that the shocks in oil prices do not propagate into the stock markets of SAARC member countries and investors need to consider other macro and micro economic factors. Further, the findings are important for policymakers to formulate effective and efficient market strategies and policies.

7. Future Recommendations

There are a few worthy future research recommendations. First, the study can extend by including other macroeconomic factors like energy consumption, renewable energy, economic growth, and trade deficit. Second, results can be more worthy by considering structural breaks and extreme quantile effects.

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